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AIR FORCE PACKAGING EVALUATION AGENCY WRIGHT-PATTERSON-ETC F/G 13/4  
EVALUATION/REDESIGN OF THE F-105 PITCH RATE GYRO PACK, (U)

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**LEVEL II**

PTPT REPORT NO. 80-16  
AFPEA PROJECT NO. 80-P7-21

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AD A092109

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EVALUATION/REDESIGN OF THE F-105 PITCH RATE GYRO PACK

AFALD/PTP  
AIR FORCE PACKAGING EVALUATION AGENCY  
Wright-Patterson AFB OH 45433

OCTOBER 1980

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## ABSTRACT

The F-105 Pitch Rate Gyro Pack was subjected to rough handling tests in compliance with Federal Test Method Standard 101B. The objective of this testing was to determine the level of shock protection provided for the Pitch Rate Gyro and to redesign the container if the current pack does not provide a 15 G level of protection, the rated fragility value for the item. It was determined that the pack presently used does not provide the required level of protection, therefore the pack was redesigned to provide a 15 G level of protection.

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PUBLICATION DATE:

28 OCT 1980

APPROVED BY: *Jack E. Thompson*  
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Director, Air Force Packaging  
Evaluation Agency

## INTRODUCTION

OC-ALC/DSPA requested this Agency provide support for the investigation of the packaging of the F-105 Pitch Rate Gyro, NSN 6615-00-618-6194. This request was initiated as a result of the Mean Time Between Failures (MTBF) reported for the item and the limited number in the system. The excessive damage rate for the gyro has been attributed to the current packaging for the shipment of the item. This Agency was requested to redesign the pack, if necessary.

## TEST INSTRUMENTATION AND EQUIPMENT

The following equipment and instrumentation was used in evaluation of packaging for the Pitch Rate Gyro:

1. Oscilloscope, 4 channel storage, Tektronix Model 564-B.
2. Accelerometer (2 ea.), Endevco Model 2233E.
3. Amplifier (2 ea.), Endevco Model 2614E.
4. Power Supply, Endevco Model 2622C.
5. Drop Tester, Gaynes Engineering Company.

## DESCRIPTION OF CURRENT PACK

The pack currently used for the F-105 pitch rate gyro is a standard plastic fast pack, Type I, NSN 8155-01-8101, measuring 6 x 6 x 10 inches (O.D.). The interior cushioning insert is fabricated from polyurethane foam (1.5 lbs/cu. ft). The cushion insert consists of top and bottom pads 3 inches thick and a center section with a cutout in the shape of a six pointed star.

## DESCRIPTION OF REDESIGNED PACK

Structural details for the redesigned pack are presented in Figure 1. The outer shipping container is fabricated from double wall corrugated fiberboard. All cushioning pads are polyurethane foam (ether), density 1.5 lbs/cu. ft. The side pads are glued to a full height inner liner of double wall fiberboard. The side cushioning pads are stress cut to allow for optimum deflection and energy absorption and are positioned to provide balanced load support. Stress cut pads are glued to the bottom and top face of the container. The inner container is a standard plastic fast pack, Type I, NSN 8115-01-044-8101, with polyethylene foam (2 lbs/cu. ft.) substituted for the original polyurethane cushioning insert.

## TEST PROCEDURES

The current and redesigned packs were each tested in compliance with Federal Test Standard 101B, Procedure A, Method 5007. The packs were dropped once on each flat face, edge, and corner from a height of 30 inches using a Gaynes Drop Tester.

## RESULTS

### 1. Current pack

The average shock levels recorded were in the range of 35-45 Gs for the first drop on each face of the container and increased to a level of 75-90 Gs as the container was dropped repeatedly on any one face or edge.

### 2. Redesigned pack

The average shock levels recorded for the redesigned pack were in the range of 12-14 Gs for flat face, corner, and edge drops. The shock levels remained consistent as the container was dropped repeatedly on identical faces and edges.

## DISCUSSION

The shock levels transmitted to the gyro, when packaged in the standard type I fast pack, increased as the container was repeatedly dropped on the same face or edge. The increase in shock level can be attributed to the movement of the gyro within the container. After repeated impacting, the gyro tended to shift in the direction of the impact, becoming wedged between the two side pads thus preventing the item from returning to its original position. This in effect limited the thickness of the cushioning material available for energy absorption. The reduction in the thickness of the cushioning material allowed the item to bottom out during impact and significantly increased the shock level transmitted to the gyro.

The gyro was placed in a plastic fast pack lined with polyethylene to provide added weight and increase the bearing area. The added weight allows the cushioning material to be deflected during impact and absorb energy. The increased bearing area distributes the load over a larger area thus reducing the static stress on the material and allows for maximum shock absorption during impact.

## CONCLUSIONS

The redesigned pack can maintain a shock protection level of 15 Gs identified as the fragility of the gyro.

### RECOMMENDATIONS

1. The current pack used for the shipment of the gyro should be discontinued.
2. Implement the use of the redesigned pack.
3. Identify other gyro's in the system as possible candidates for this type of design.

**PRESERVATION AND PACKAGING**

LEVEL "A" IN A/W SPEC MIL-P-116  
 METHOD I-A-B DESICCANT N/A  
 PRESERVATIVE N/A

LEVEL "B" NOT APPLICABLE

LEVEL "C" SAME AS LEVEL "A"

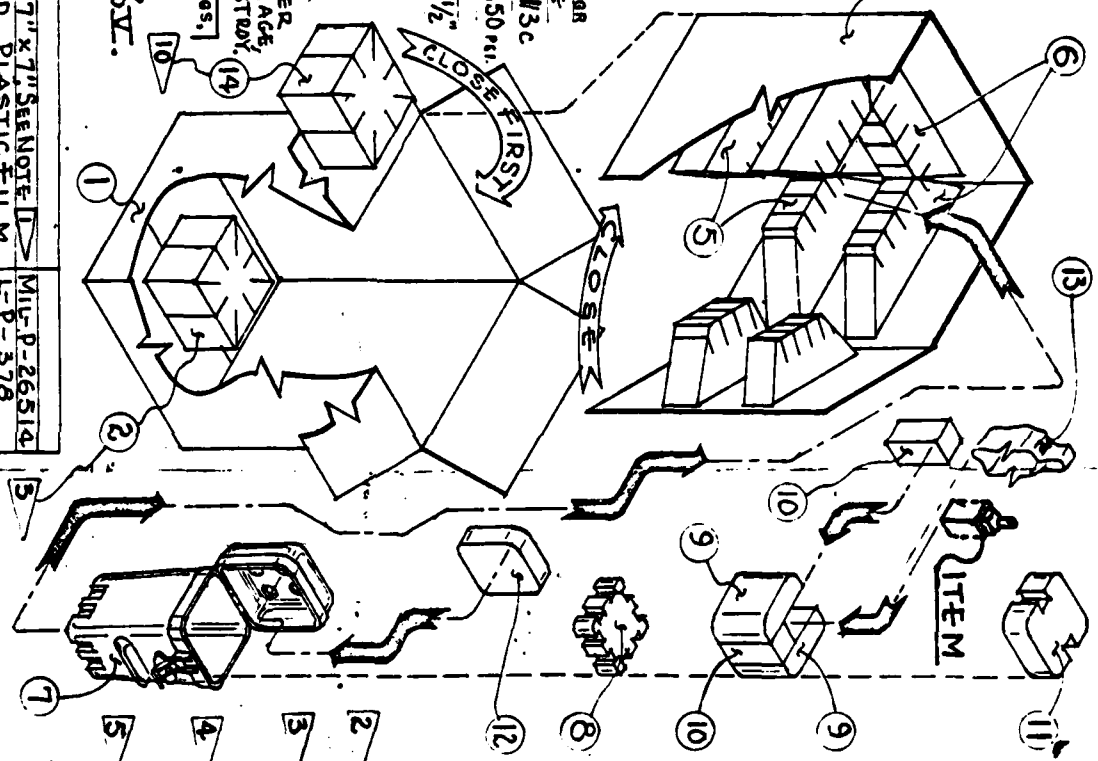
CLEANING AND DRYING  
 IN A/W SPEC. MIL-P-116

**PACKING**

SHIPPING CONTAINERS SHALL CONFORM TO REQUIREMENTS SPECIFIED BELOW AND LIST OF MATERIALS IN A/W REQUIRED OR STIPULATED LEVEL OF PACKING FOR THE MODE OF SHIPMENT

LEVEL A NOT APPLICABLE  
 LEVEL B 6536 CFWR DW W3C  
 LEVEL C " " " DOM. " 350 PSI  
 OUTSIDE DIM 518" x 18" x 22 1/2"  
 ITEM - NET WEIGHT 1.00 LBS 4 1/4 x 2 1/8 - 1 1/2"  
 GROSS CUBE 4.21 CU. FT.  
 GROSS WEIGHT 13.00 LBS.

MARKING AND CLOSURE  
 MARK T.P.O. AND NUMBER ON EXTERIOR CONTAINER.  
 IN ADDITION TO OTHER SPECIFIED MARKINGS, CONTAINERS SHALL BE MARKED I. A. W. MIL-STD-129.  
 CLOSURE / IAW PPP-B-636 METHOD IV AND V.



PART NO.	RECD.	DESCRIPTION
1		TOP CUSHION - 5" x 7" x 7" SEE NOTE 1
2		WRAP - SIZE AS REQ'D. PLASTIC FILM
3		TOP PAD - 2" x 5 3/4" x 5 3/4"
4		TOP INSERT - 2" x 5 3/4" x 5 3/4"
5		END INSERT - 2" x 2" x 4 1/2"
6		SIDE INSERT - 2" x 4 1/2" x 5 3/4"
7		BASE INSERT - 2" x 5 3/4" x 5 3/4"
8		CARTON - I.D. 6" x 6" x 10" SEE NOTE 2
9		UPPER CUSHION - 3" x 4 3/4" x 16 1/2" SEE NOTE 3
10		LOWER CUSHION - 3" x 5 3/4" x 16 1/2" SEE NOTE 4
11		LINER - 5/16" x 21" x 69 1/16" SEE NOTE 5
12		ADHESIVE - QUANTITY AS REQUIRED
13		BASE CUSHION - 5" x 7" x 7" SEE NOTE 6
14		CONTAINER - I.D. 17 1/2" x 17 1/2" x 21 1/2"

ITEM	ILLUSTRATOR	DATE
1	PL. TUCKER	8/12/60
2	W. J. Schell	8/13/60
3	W. J. Schell	8/13/60
4	W. J. Schell	8/13/60
5	W. J. Schell	8/13/60
6	W. J. Schell	8/13/60

TABLE NUMBER ONE

NATIONAL STOCK NUMBER	CONTRACT PART NUMBER
6615-00-618-6193	204C946G1
" - 6194	204C957G1
" - 653-1175	213B257G1
" - 580-3448	204C957G3

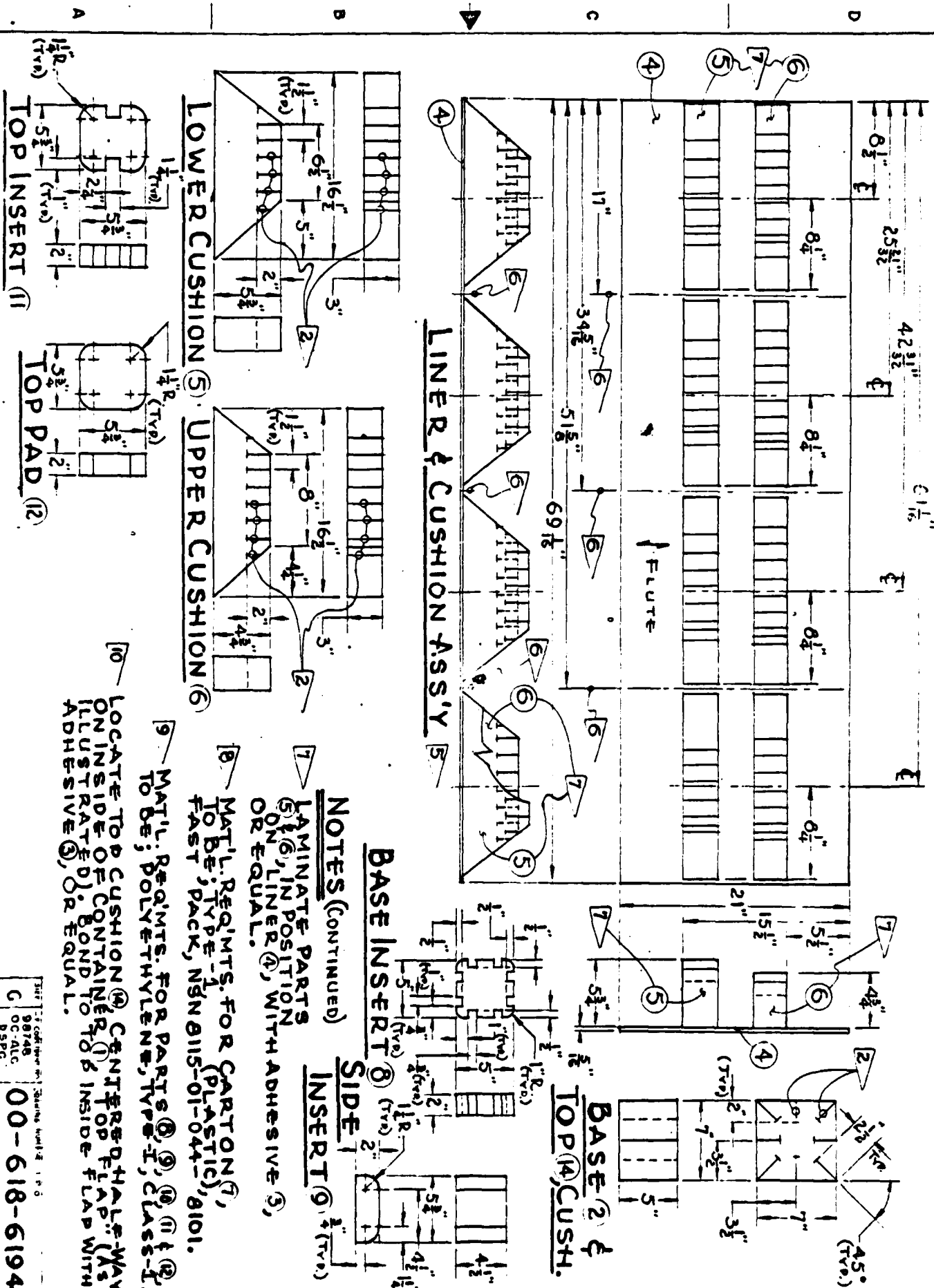
**NOTES**

1. MATERIAL REQUIREMENTS FOR PARTS TAKE TYPE-I, CLASS-2 GEXOE DENSITY 1.5 LBS. PER CU. FT.
2. ACCOMPLISH STRESS CUTS WITH SAW BLADE, MAX. THICKNESS 1/8"
3. BOND BASE CUSHION IN CENTER OF CONTAINER (BOTTOM) WITH ADHESIVE (3) OR EQUAL.
4. MATERIAL REQUIREMENTS FOR LINE R, TO BE TYPE-CF, CL-DOM, VAR.-DW, GR.-350 PSI.
5. ARROW "F" INDICATES DIRECTION OF FOLDING.
6. SCORE ON CENTER LINES FOR BENDING & FOLDING.

NOTES CONTINUED ON SHEET 2042

RATE GYRO

00-618-6194



**FIGURE**



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SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

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20. ABSTRACT (Continue on reverse side if necessary and identify by block number) The F-105 Pitch Rate Gyro Pack was subjected to rough handling tests in compliance with Federal Test Method Standard 101B. The objective of this testing was to determine the level of shock protection provided for the Pitch Rate Gyro and to redesign the container if the current pack does not provide a 15 G level of protection, the rated fragility value for the item. It was determined that the pack presently used does not provide the required level of protection, therefore the pack was redesigned to provide a 15 G level of protection.		

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